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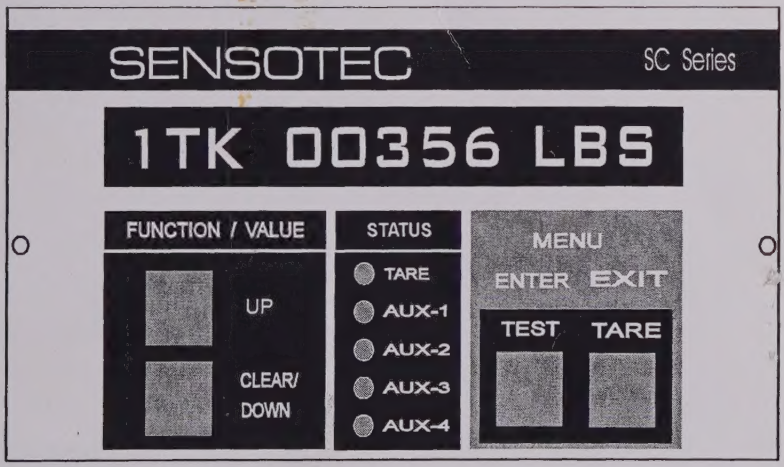
MODEL SC100

SIGNAL CONDITIONER AND INDICATOR



SENSOTEC
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SC100 User's Guide
SENSOTEC Part Number: 008-0426-00
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Chapter 1

Introduction

1.1 What is the SC100?

The SENSOTEC Model SC100™ Signal Conditioner/ Indicator is a versatile device designed to operate with strain-gage sensors, such as pressure and load cell transducers. The main features of the SC100 are:

- Up to four channels to handle four signal sources
- Automatic setup, calibration, and scaling through the use of *Signature Calibration*™
- 16-bit resolution (up to 65,536 parts)
- Full six-digit (999,999 maximum) display
- RS-232 or RS-485 communications options
- Local or remote setup using the RS-232 or RS-485 port
- Rugged 3/8 DIN aluminum case for bench, panel or rack mounting
- Push-button on/off tare feature
- No knobs or adjustments

1.2 What is *Signature Calibration*?

A small, battery-operated RAM memory is located inside the transducer (or in an in-line package between the SC100 and the transducer). This memory uses a lithium battery with a guaranteed lifetime of 10 years. All data necessary to set up the transducer with the instrument is stored (even linearity data), and setup is automatic when the calibration function is activated.

The SENSOTEC Model SC100 is designed to operate with *Signature Calibration*. It will automatically set itself up with transducers which contain the memory device, but can also be set up using a front panel interactive procedure. The *Signature Calibration* module can also be programmed from the SC100's front panel.

2.1 Quick Start

When Does Quick Start Apply?

You can use the Quick Start procedure when:

- you are using a transducer with *Signature Calibration*, or
- the transducer and SC100 were purchased together and set up by SENSOTEC

Quick Start with *Signature Calibration*

This section outlines the steps for getting started using the SC100 if you have a transducer with *Signature Calibration*.

1. Connect the Transducer

Connect your transducer to the Amplifier Board connector. For pin connections, see Table 4.1.

2. Start up the SC100

Connect the power cord to the power source, and turn the On/Off switch on the back of the SC100 to the On position.

The SC100 runs through a test mode that lasts a few seconds. During this time, the transducer's serial number may be seen on the display. When the SC100 enters its normal operating mode (RUN mode), you will see the following format on the front panel display:

X TK 00000 PSI
where:

X
is the channel number (omitted for single-channel instruments).

TK
indicates tracking mode. The SC100 "tracks" the signal, continuously updating the display in response to the signal from the transducer.

00000
displays the current value from the transducer (in engineering units) in Track mode.

PSI
indicates the engineering units being used (you can change this in the setup procedure, Section 4.4).

3. *You're Ready to Use the SC100*

Apply some test stimulus on the transducer to observe changes in the SC100 display.

4. *Tare the Display (if desired)*

To set the display to zero, after placing a constant stimulus on the transducer, press the TARE button. To restore the tare value, press the TARE button a second time.

5. *Select a Different Channel (Multi-channel instruments only)*

If you have a multi-channel instrument, press the TEST button to move to a different channel. When you release the button, you will see the new channel number on the display.

To increment the channel number by one, again press TEST, then release.

Quick Start when Set Up by SENSOTEC

When the transducer and the SC100 were purchased together and set up by SENSOTEC at its factory, Quick Start applies.

1. *Connect the Transducer*

Connect your transducer to the Amplifier Board connector. For pin connections, see Table 4.1.

2. *Start up the SC100*

Connect the power cord to the power source, and turn the On/Off switch on the back of the SC100 to the On position.

The SC100 runs through a test mode that lasts a few seconds. During this time, the transducer's characteristics, previously loaded into the SC100's memory, are being used to calibrate the SC100. When the SC100 enters its normal operating mode (RUN mode), you will see the following format on the front panel display:

X TK 00000 PSI
where:

X
is the channel number (omitted for single-channel instruments)

TK
indicates tracking mode. The SC100 "tracks" the signal, continuously updating the display in response to the signal from the transducer.

00000
displays the current value from the transducer (in engineering units) in Track mode

PSI
indicates the engineering units being used (you can change this in the setup procedure, Section 4.4)

3. You're Ready to Use the SC100

Put some test stimulus on the transducer to observe the SC100 display change in response to it.

2.2 When Quick Start Does Not Apply.....

If Quick Start does not apply to your case, a more general start-up procedure will do the job. See Chapter 4 for this procedure.

3.1 Main Features of the SC100

To simplify discussion of the operation of the SC100, consider the significant features available on this unit.

Signature Calibration

A key feature of the SC100 is the ability to use *Signature Calibration* for automatic setup. If your transducer uses *Signature Calibration*, the SC100 reads information from the transducer's memory to set itself up. For more information about *Signature Calibration*, see the Appendix section A.2.

Auto-Zero Function

The SC100 performs an auto-zero function every 10 seconds, in which the display reverts to zero in the absence of a signal. Auto-zeroing occurs when the signal has not exceeded 10 display counts during the past 10 seconds. This feature has two advantages:

- It removes the effect of slight temperature shifts that occur in the transducer's output.
- It eliminates the need for potentiometer adjustments for zero.

If you want, you can disable this function through the AUTO-ZERO menu item in SETUP mode, as described in Section 4.4.

Important: During the first minute after you start up the SC100, the auto-zero function operates every two seconds to compensate for the transducer's initial warm-up.

Automatic Check

Another feature is automatic self-checking, which occurs regularly every 60 seconds The SC100 checks itself for gain and zero accuracy, once per minute if the Auto-Check feature is turned on.

You can disable automatic checking through the AUTO- CHECK menu item in SETUP mode, described in Section 4.4.

Flexible Calibration Methods

Four separate methods of calibrating the instrument exist. They are:

- Shunt Calibration ("R-Cal")
- Millivolt-per-volt Calibration
- Known-Load Calibration
  - 2-point Known-Load
  - 3-point Known-Load

During the SETUP procedure, the user may select the calibration method that is most applicable to his use of the SC100. All of these methods can be used in conjunction with *Signature Calibration*.

Remote Sensing of Excitation

The SC100 provides remote sensing of its excitation voltage, in order to keep the Analog-to-Digital converter (ADC) circuitry correct in output values. This feature improves accuracy, particularly if your transducer cable is very long or is subject to temperature variations. For short cables, two jumpers installed on the Amplifier connector bypass this feature.

Removing a Preload (Tare)

The starting point of a measurement may not always be a true zero. This is called a preload. An example might be the weight of a scale platform, where we only desire to weigh the contents of the scale, rather than the total weight.

You can use either of these two methods to remove a preload from the display.

- If the Power-On Cal feature is turned on, de-energize the instrument, then turn it back on. When you start up the SC100, the Power-On Cal feature causes the instrument to zero out its initial load. If Power-On Cal is turned off, the display will not zero when the power is applied.

- Press the TARE/EXIT button, which serves to zero the instrument in the presence of a load up to full scale. Pressing TARE/EXIT alternately applies and removes the tare value.

3.2 Operating Procedures

This section shows you the operating procedures for the SC100. It is assumed that the instrument has either been setup automatically (see Section 2.1 -- Quick Start), or manually (see Chapter 4).

Start up the SC100

1. Connect the power cord to the power source.
2. Turn the On/Off switch on the back panel to the On position.

Normal Operation after Start-Up

Each time you start up the SC100, it runs through a test mode. The instrument then enters its normal operating mode, called RUN mode.

1. Test Mode

The SC100 enters a test mode that lasts a few seconds. During this time, you will see all the LED indicators on the front panel illuminate momentarily.

In the test mode, the SC100 performs the following tasks.

- Calibrates the analog-to-digital converter (ADC).
- Checks the serial transmission link that sends information between boards within the instrument.

- Attempts to read the transducer's *Signature Calibration* module information. If your transducer uses *Signature Calibration*, the SC100 uses that information to set itself up. For each channel, you will see the transducer's serial number displayed for about one second. (If your transducer has no *Signature* module, you will not see the serial number on the display.)

2. RUN Mode

When the test mode finishes, the instrument enters RUN mode, its normal operating mode. You will see the RUN mode display as shown in Figure 3.2.

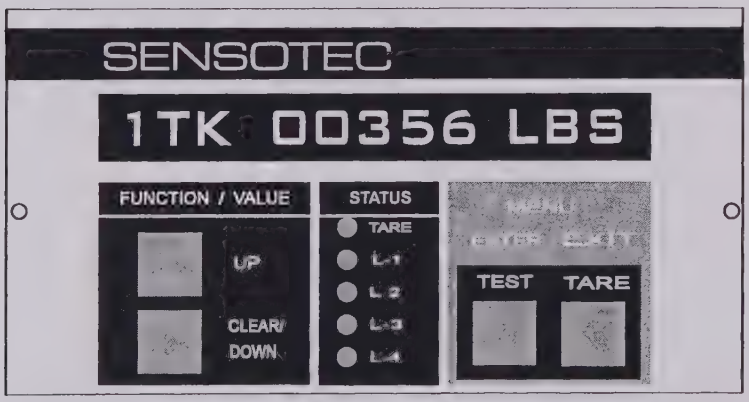


Figure 3.2 -- Front Panel in RUN Mode

The display format is shown below:

X TK 00000 PSI
where:

X
is the channel number (omitted for single-channel instruments).

TK
indicates tracking mode. The SC100 "tracks" the signal, continuously updating the display in response to the signal from the transducer.

00000
displays the current value from the transducer (in engineering units) in Track mode.

PSI
indicates the engineering units being used (you can change this in the setup procedure, Section 4.5).

If the SC100 detects an error, the display shows an error code in the format:

ERROR XXYY
where:

XX
is the Channel number (e.g., 01)

and:

YY
is the error code

For example, ERROR 0163 means the SC100 has detected error code 63 (signal exceeds full scale) on Channel 01. For a complete list of error codes, see Section A.1.

3. TARE Button

To reset the display to zero, press the TARE/EXIT button while in RUN mode. To restore the tare value, press the TARE/EXIT button again. The TARE light will illuminate when tare is on.

4. Automatic Functions

During normal operation, the SC100 has two automatic functions that occur at regular intervals. Either or both functions may be enabled or disabled in SETUP mode.

Auto-Zero Function (AUTO-ZERO)

When the auto-zero function is enabled (the default), the display reverts to zero once every 10 seconds when there is "no signal" present. "No signal" is defined as 10 counts or less on the display.

You can disable the Auto-Zero function in SETUP mode.

Automatic Checking (AUTO-CHECK)

When automatic checking is enabled, the instrument checks its ADC calibration once every 60 seconds. While checking is taking place, you will see the display fill with dashes (----------). The display returns to RUN mode when calibration is complete. The channel number may also be displayed with the dashes during Auto-Check.

You can disable the Auto-Check function in SETUP mode.

5. Changing Channels

If you have a multi-channel SC100, use the following steps to move to a different channel.

- In RUN mode, press (but do not hold) the TEST button.
- When you release the button, you will see the new channel number on the display.
- Continued pressing of the TEST button will cause the channel number to increase through the entire range of available channels.
- If the TEST button is pressed and held for 3 seconds, the channel's shunt calibration value, for the cell calibrated to it, will be displayed.

4.1 Overview of the SETUP Procedure

This section assists you with the application, wiring and setup of the SC100.

Available Input Signal Levels

The SC100 is designed to work with a wide variety of input signal levels, to cover the many transducers available.

Signal Type	Signal Limits	Comments
Millivolt	0.40 to 12 mv/v	Automatically adjusted
Volts	1 to 10	Optional
Milliamperes	0-to-20 and 4-to-20	Optional

Hardware Setup

The SC100 is designed for bench mounting, panel mounting, or rack mounting. If you choose bench mounting, you may want the optional carrying handle/ bench stand (part number 032-0447-00).

1. Panel and Rack Mounting Instructions

The SC100 has two Rack-Mounting Jacks (part number 032-0438-00) that slide into two slots at the sides of the instrument.

- In the panel or rack, cut a hole 5.35" wide by 2.68" high. The panel may be up to 1/4" in thickness.
- Use a 0.062" Allen wrench to remove two setscrews that hold the Rack Mounting Jacks to the case. To do this, insert the wrench into the side slots at the rear. Remove the screws completely.
- Remove the Rack Mounting Jacks by sliding them toward the rear. If the jacks don't slide easily, tap them gently.
- Put the SC100 through the hole in the panel.
- Reinsert the Rack-Mounting Jacks into the slide slots. Slide them as far toward the panel as possible.
- Reinsert the setscrews and tighten them. This will force the Rack-Mounting Jacks toward the rear side of the panel, drawing the instrument tightly into place.

2. Wiring the Transducer to the Amplifier Board Connector

To connect your transducer to the SC100, you need to wire it to the 12-pin connector on the rear of the Amplifier Board. The pin-out for this connector is shown on the following table (Table 4.1).

Table 4.1: Amplifier Board Pin Connections

Pin	Function
1	+ Excitation
2	+ Sense
3	- Sense
4	- Excitation
5	+ Signal
6	- Signal
7	Analog Out (+/- 5V, 0-10V, or 4-20mA)
8	AGND (Analog Ground)
9	*Signature Cal.* Memory +
10	DGND (Digital Ground)
11	Aux. Input 1
12	Aux. Input 2

IMPORTANT: If you are not using remote sensing of excitation, jumper +Sense (#2) to + Excitation (#1) and - Sense (#3) to - Excitation (#4).

The Analog Output signal (pin #7) is the voltage output of a digital-to- analog converter. This will be scaled and corrected digitally to the engineering units that you specify in SETUP mode. The Analog Output Signal value is usually +/- 5 volts, it can optionally be 0-10 volts or 4-20mA. If the optional wide-band analog output has been purchased, the analog output on pin #7 will be an amplified copy of the transducer signal, with a bandwidth of 0 to 1kHz. Rear panel potentiometers are used to set zero and span. Digital correction by microprocessor is not performed on this output.

3. Wiring for Communications

The 25-pin Microprocessor connector serves as an interface between the SC100 and the user in these circumstances:

- Communication by RS-232 or RS-485, both to and from the SC100
- Use of digital inputs, such as for resetting tare

The connector itself is a D-subminiature device, familiar to users of digital communications. In such communications, certain pins are reserved for such functions, and these standard designations have been maintained. Table 4.2 lists the functions of the pins of the Microprocessor connector.

SETUP Procedure

The SC100 has a SETUP mode that allows you to display or change settings that control the operation of the instrument.

These settings are accessible through menus, which appear in the display on the front panel after you enter SETUP mode. The SC100 has four types of setup menus, and each menu contains various menu items.

1. Setup Menus

The following menus are available in SETUP mode. The remaining sections of this chapter provide more detail about each type of menu.

Menu Type	Description
SYSTEM	Contains system-wide parameters including excitation voltage.
SERIAL COM	Displays the settings for communications with the RS-232 or RS-485 interface.
Channel menus (CHANNEL 1-4)	Lets you define parameters for up to four transducers. (For a single-channel SC100, only CHANNEL 1 is active.) If your transducer uses *Signature Calibration*, setup values are entered automatically.

Table 4.2: Microprocessor Board Pin Connections

Pin	Function
1	No Connection
2	Data In (RS-232 only)
3	Data Out (RS-232 only)
4	Clear to Send (connected to pin 5)
5	Request to Send (connected to pin 4)
6	Data Set Ready
7	DGND (Digital Ground)
8	Data Carrier Detect (pulled up to +5V)
9	Digital Input #2
10	Digital Input #1 - Clear Tare
11	Digital Input #0
12	Transmit B (RS-485 only)
13	Transmit A (RS-485 only)
14	No Connection
15	No Connection
16	No Connection
17	No Connection
18	No Connection
19	DGND (Digital Ground)
20	Data Terminal Ready (not connected)
21	Digital Input #3 - Tare on
22	Ring Indicator (not connected)
23	No Connection
24	Receive B (RS-485 only)
25	Receive A (RS-485 only)

IMPORTANT: To use the Digital Input pins (#9-11,21), connect the pin to DGND momentarily. You can have other functions programmed for these pins on special order.

2. Entering SETUP Mode

- To enter SETUP mode, press and hold the UP and DOWN buttons at the same time. You will see SETUP.
- When you release the buttons, you will see the first SETUP menu (SYSTEM).
- To leave SETUP mode and return to RUN mode at any time, press EXIT. (If a numeric value is displayed, first press ENTER repeatedly to move through the displayed digits and to the next menu item, then press EXIT to return to RUN mode.)

3. Moving Through SETUP Menus and Menu Items

The following steps show you how to move through menus and menu items and how to display or change the setting of a particular item.

Action	Description
Scroll through menus	Press DOWN to scroll through menus one at a time. Press UP to move to a previous menu.
Select a menu	Press ENTER to display the first menu item.
Scroll through menu items	Press DOWN to scroll through menu items one at a time. Press UP to move to a previous menu item.
Display the current setting of a menu item	When you see the menu item displayed, press ENTER. To move to the next menu item without changing the setting, press ENTER again.
Change the setting of a menu item	Press ENTER to display the current setting. Press UP or DOWN until you see the setting you want. To accept the new setting and move to the next item, press ENTER.

IMPORTANT: Once you select a menu, you cannot move to a different menu while in SETUP mode. To do this, you must first return to RUN mode (by pressing EXIT), then enter SETUP mode again (by pressing UP and DOWN together).

4. Leave SETUP Mode

To leave SETUP mode and return to RUN mode at any time, press EXIT. (If a numeric value is displayed, first press ENTER repeatedly to move through the displayed digits and to the next menu item, then press EXIT to return to RUN mode.)

4.2 SYSTEM Menu

The SYSTEM menu allows you to set the transducer excitation voltage which will be sent to all transducers and to display the software revision resident in the SC100.

Moving to the SYSTEM Menu

1. Press and hold the UP and DOWN buttons at the same time to enter SETUP mode. You will see SETUP.
2. Release the buttons, and you will see SYSTEM menu.
3. Press ENTER to move into the SYSTEM menu.

To leave SETUP mode and return to RUN mode at any time, press EXIT.

Overview of SYSTEM Menu Items

The SYSTEM menu contains the following items. The remainder of this section provides more detail about each menu item.

Menu Item	Description
EXCITATION	Sets the excitation voltage at 5 or 10 volts DC to be sent to all transducers
SOFTWARE REVISION	Displays the software revision that is resident in this SC100 (cannot be changed)

A Closer Look at the Menu Items

These descriptions provide more detail about the two SYSTEM menu items.

EXCITATION

Allows you to set the excitation voltage that is to be sent to all transducers.

The two options for this menu are:

- 5 volts DC
- 10 volts DC

Action

- When EXCITATION is displayed, press ENTER to display the current setting.
- To change the setting, press UP or DOWN until you see your choice in the display. Then press ENTER to accept the displayed setting and move to the next menu item, SOFTWARE REVISION.

SOFTWARE REVISION

Displays the software revision that is resident in your SC100.

Action

- When the display shows SOFTWARE REVISION, press ENTER to display the current setting. You cannot change this setting.
- Press ENTER to move back to the first menu item, EXCITATION. To leave SETUP mode and return to RUN mode, press EXIT.

4.3 SERIAL COM Menu

The SERIAL COM menu allows you to display the settings for serial communications using the RS-232 or RS-485 interface.

Moving to the SERIAL COM Menu

1. Press and hold the UP and DOWN buttons at the same time to enter SETUP mode.
2. Release the buttons and you will see SYSTEM.
3. To move to the SERIAL COM menu, press DOWN repeatedly until you see SERIAL COM displayed. (As you press DOWN, you will see SYSTEM, and then SERIAL COM).

To leave SETUP mode and return to RUN mode at any time, press EXIT.

Overview of SERIAL COM Menu Items

The SERIAL COM menu contains the following items. The remainder of this section provides more detail about each menu item.

Menu Item	Description
COM. ADDRESS	Displays the address of the instrument on the serial bus (normally "00").
BUAD RATE	Displays the baud rate, or speed of transmission (normally 9600).
AUTO LINE-FEED	Displays the setting for automatic line feed during communication (usually on).
TRANSMIT TEST	Used to check out the serial link. Transmits "ADDRESS nn TEST" on the serial link.

IMPORTANT: ***You cannot change settings for the SERIAL COM menu items through the front panel of the SC100. For instructions on how to change these settings, see Chapter 5, Data Communications.***

A Closer Look at the Menu Items

These descriptions provide more detail about the SERIAL COM. menu items.

COM. ADDRESS

Displays the address that your SC100 has on the serial bus.

Action

- When ADDRESS is displayed, press ENTER to display the current setting. Normally, this address is 00.
- To move to the next menu item (BAUD RATE), press ENTER.

BAUD RATE

Displays the baud rate, or the speed at which data are transmitted between the SC100 and a data terminal. The rate of transmission refers to the number of bits sent each second.

Action

- When BAUD RATE is displayed, press ENTER to display the current setting. The default baud rate for the SC100 is 9600 baud.
- To move to the next menu item (AUTO LINE FEED), press ENTER.

AUTO LINE-FEED

Displays the setting for automatic line-feed during serial communication. When this menu item is ON, the data terminal moves one line lower on the screen each time a carriage return is received. When automatic line feed is OFF, a new line will overwrite the previous line.

Action

- When AUTO LINE-FEED is displayed, press ENTER to display the current setting. Typically, the setting is ON.
- To move to the next menu item (TRANSMIT TEST), press ENTER.

TRANSMIT TEST

When activated, transmits "ADDRESS nn TEST" on the serial communications link. After the test message is transmitted, the display will read "MESSAGE SENT".

Action

- When TRANSMIT TEST is displayed, pressing ENTER causes the message to be sent. The words "ADDRESS nn TEST" should appear on the terminal's screen. Further, the words MESSAGE SENT will appear on the display of the SC100.
- Press ENTER to move back to the first menu item, ADDRESS. To return to RUN mode, press EXIT.

4.4 Channel Menu

There are up to four transducer Channel menus, which allow you to define parameters for up to four transducers. You will see these menus displayed as CHANNEL 1 MENU, CHANNEL 2 MENU, CHANNEL 3 MENU, and CHANNEL 4 MENU. (Additional channels may be assigned as math channels and other purposes.)

The SC100 is capable of four transducer channels. (Additional channels may be dedicated to other uses, such as math channels). If you have a single-channel instrument, only CHANNEL 1 will be active.

The same settings apply to all four transducer Channel menus. To simplify the discussion, we use the term *Channel menu* to refer to any of these menus.

Moving to a CHANNEL Menu

1. Press and hold the UP and DOWN buttons at the same time to enter SETUP mode. You will see SETUP.
2. Release the buttons, and you will see SYSTEM MENU.
3. To move to the CHANNEL 1 menu, press UP or DOWN until you see CHANNEL 1 in the display.

To leave SETUP mode and return to RUN mode at any time, press EXIT. (If you are entering a numeric value during the DAC or CALIBRATION setup steps, first press ENTER repeatedly to move through the displayed digits and to the next menu item, then press EXIT to return to RUN mode.)

IMPORTANT: ***If you change a setting for a menu item, be sure that you press ENTER to accept the displayed setting before pressing EXIT to return to RUN mode.***

Overview of CHANNEL Menu Items

The transducer Channel menu contains the following items. The remainder of this section provides more detail about each menu item.

Menu Item	Description
AUTO-ZERO	Turns the auto-zero function ON or OFF for this channel.
AUTO-CHECK	Enables or disables automatic calibration checking for this channel once per minute.
POWER-ON CALIBRATION	Enables or disables automatic calibration upon power-up for this channel.
DISPLAY	Contains items that let you control the display of numbers and units:
DISPLAY DIGITS	Lets you specify the display of numbers as BIPOLAR (positive and negative numbers) or UNIPOLAR (positive numbers)
DISPLAY DEC. PT.	Allows you to specify the location of a decimal point. (If not shown, the decimal point is implied at the right of all digits).
DISPLAY COUNT-BY	Allows you to designate up to two positions as inactive digits, which will always read 0.
DISPLAY UNITS	Allows you to specify engineering units using up to four characters (letters, numeral or blanks).
DISPLAY AVERAGE	When ON, the display will average readings and update four times per second. When OFF, display updates very rapidly.

Menu Item	Description
DAC SETUP	Contains items to control the instrument setup and the output signals:
DAC. CHANNEL	Allows you to select which channel will drive the output signal.
DAC. SOURCE	Allows you to specify whether the output signal is driven by the peak, track, or valley signal.
DAC. ZERO SCALE	Allows you to specify the value in engineering units which will produce a zero-value output signal.
DAC. FULL SCALE	Allows you to specify the value in engineering units which will produce a full-scale output signal.
CONVERSION RATE	Displays the analog-to-digital converter's rate in samples/sec.
CALIBRATION TYPE	Allows you to specify which type of calibration (shunt cal., millivolts/volt cal., or known load cal.) that you wish to use for this channel.
CALIBRATION DATA	Allows entry of calibration data for the transducer being used, based upon your choice of calibration type.
CALIBRATE	Causes the SC100 to recalibrate using the information provided to it in the last two steps.
UPDATE SIG. MOD?	Causes the SC100 to update the Signature module information, then return to RUN mode.
DEFAULT SIG. MOD?	Causes the SC100 to overwrite any user settings with the factory defined settings from the Signature module, then return to RUN mode.

A Closer Look at the Menu Items

These descriptions provide a closer look at the options for each of the Channel menu items.

AUTO ZERO

Allows you to enable or disable the auto-zero function for this channel. When enabled, this function causes the SC100 to reset the display to zero every 10 seconds when no signal is present. "No signal" is defined as 10 display counts or less for a period of 10 seconds. This removes the effect of slight temperature shifts in the transducer's output, and removes the need for any potentiometer adjustments for zero. Auto-zeroing does not occur when the signal exceeds the amount required to produce 10 counts on the display.

IMPORTANT: To compensate for the transducer's initial warm-up shift, the auto- zero function operates every two seconds during the first 60 seconds after the SC100 is energized.

The two options for this menu are:

- ON means the auto-zero function is active.
- OFF disables the auto-zero function.

Action

- When AUTO-ZERO is displayed, press ENTER to display the current setting.
- To change the setting, press UP or DOWN until you see your choice in the display (ON or OFF). Then press ENTER to accept the displayed setting and move to the next menu item, AUTO-CHECK.

AUTO-CHECK

Enables or disables the automatic calibration checking that occurs once per minute, which compensates for temperature change, if needed.

The two options for this menu are:

- ON will permit the automatic calibration check to occur once per minute in the absence of any signal which causes the display to show 10 counts or more.
- OFF disables the automatic calibration checking feature.

Action

- When AUTO-CHECK is displayed, press ENTER to display the current setting.
- To change the setting, press UP or DOWN until you see your choice in the display. Then press ENTER to accept the displayed setting and move to the next menu item, POWER-ON CAL.

POWER-ON CAL

Enables or disables the automatic calibration which can occur when power is applied to the instrument.

The two options for this menu are:

- ON will permit calibration to occur upon power-up.
- OFF disables the calibration upon power-up.

Action

- When POWER-ON CAL is displayed, press ENTER to display the current setting.
- To change the setting, press UP or DOWN until you see your choice in the display. Then press ENTER to accept the displayed setting and move to the next menu item, DISPLAY.

DISPLAY

The DISPLAY menu contains five sub-menus that let you control the display of numbers and units on the SC100.

Action

- When DISPLAY appears, press ENTER to display the first sub-menu item, DISPLAY.DIGITS.

DISPLAY.DIGITS

DISPLAY.DIGITS is a sub-menu which allows selection of the number of digits and range of the display for this channel. The choices are:

- BIPOLAR will display both positive and negative numbers, and has five full digits (+/- 99,999).
- UNIPOLAR will display positive numbers only, and has six full digits (0 to 999,999).

Sub-menu Action

- When DISPLAY.DIGITS appears, press ENTER to display the current setting for this sub-menu item.
- To change the setting, press UP or DOWN until you see your choice in the display.
- Then press ENTER to accept the displayed setting and move to the next sub-menu, DISPLAY.DEC. PT.

DISPLAY.DEC. PT

DISPLAY.DEC. PT allows you to place the decimal point location on the display. It will affect the display of all numbers on that channel.

Sub-menu Action

- When DISPLAY.DEC. PT appears, press ENTER to display the current setting for this sub-menu item.
- To change the setting, press UP or DOWN until you see your choice in the display. Press UP to move the decimal point one place to the right. Press DOWN to move the decimal point one place to the left. When no decimal point is displayed the location is implied at the right of all digits.

- When you see the decimal point displayed in the proper location, press ENTER to accept the displayed setting and move to the next display sub-menu, DISPLAY.COUNT-BY.

DISPLAY.COUNT-BY

DISPLAY.COUNT-BY allows you to designate up to two positions as inactive digits, so that they will always read zero. You may wish to use inactive digits to make the display less sensitive to a noisy signal.

The display shows 00001 with or without a decimal point according to your setting in the previous menu item.

The three options for this sub-menu item are:

- 00001 means all digits are active, and the display increments by 1's.
- 00010 means one digit is inactive, and the display increments by 10's.
- 00100 means two digits are inactive, and the display increments by 100's.

Sub-Menu Action

- When 00001 is displayed, press UP or DOWN until you see your choice in the display.
- When you see your choice, press ENTER to accept the displayed setting and move to the next sub-menu, DISPLAY.UNITS.

DISPLAY.UNITS

Allows you to specify the engineering units to be displayed. You can specify up to four characters, and you can use any combination of letters, numerals, or blanks.

The display shows the current setting, with the first position at the left flashing.

Sub-Menu Action

- When a position (a character or the cursor) is flashing, press UP or DOWN until you see the appropriate character or blank displayed.

  Pressing UP moves forward through the character set; pressing DOWN moves backward through the character set.

  The blank is displayed between the last alphabetic character (Z) and the first numeral (0).

- Press ENTER to accept the displayed character and move to the next position to the right.
- When the last position at the right is flashing, press ENTER to accept the displayed setting and move to the next sub-menu, DISPLAY.AVERAGE.

DISPLAY.AVERAGE

Allows you to control the rapidity with which the display will fluctuate when a moving signal is displayed. There are two choices:

- ON means that the display will update four times each second. Readings taken will be averaged for 1/4 second, then displayed. Display averaging does not affect the DAC output, or peak or limit detection, which will proceed at the analog- to-digital converter rate (usually 60 times per second).
- OFF permits the display to update at the full rate of the analog- to-digital converter.

Sub-Menu Action

- When the display indicates DISPLAY.AVERAGE, press ENTER to display the current setting.
- To change the setting, press UP or DOWN until your choice is displayed.
- To accept the setting, press ENTER. The display will indicate the next menu item, LEAVE SUB-MENU.

LEAVE SUB-MENU

The function of this sub-menu item is to allow you to quickly move to the next menu item, DAC SETUP, without the need to move through all sub-menu items, if only changing one.

Sub-Menu Action

- When LEAVE SUB-MENU appears on the display, press ENTER to move to the next menu item, DAC SETUP.

DAC SETUP

The DAC. SETUP menu contains four sub-menus that let you control the full- scale range and output of the SC100.

Action

- When DAC SETUP appears, press ENTER to display the first sub-menu item, DAC. CHANNEL.

Sub-menu Action

DAC. CHANNEL

Allows you to chose what signal you wish to serve to drive the **D**igital- to-**A**nalog **C**onverter output. Normally, the DAC located on a particular Amplifier board will be driven by that particular channel, but this need not be the case. For example, if several channels were assigned to load cells on a weighing platform, the sum of all the channels could (mathematically) drive one channel's DAC. Therefore, this sub-menu permits you to select what signal you wish to use to drive this channel's output.

- When DAC. CHANNEL appears, press ENTER to display the current setting for this sub-menu item. It will be a transducer channel number, or perhaps a math channel output.
- To change the setting, press UP or DOWN until you see your choice to drive this channel's DAC. Then press ENTER to accept the displayed setting and move to the next sub-menu, DAC. SOURCE.

DAC. ZERO-SCALE

DAC. ZERO-SCALE allows you to specify what value in engineering units you wish to correspond to zero output for the DAC.

IMPORTANT: When you enter the DAC.ZERO-SCALE sub-menu item, the DAC output (analog output) is forced to zero output volts.

Sub-Menu Action

- When DAC. ZERO-SCALE appears in the display, enter the value in engineering units that will correspond to a zero output signal from the DAC.
- When you have completed entering the value, press ENTER to accept the entry and move to the next sub-menu, DAC. FULL- SCALE.

DAC. FULL-SCALE

DAC. FULL-SCALE allows you to specify what value in engineering units you wish to correspond to full-value output for the DAC.

Sub-Menu Action

- When DAC. FULL-SCALE appears in the display, enter the value in engineering units that will correspond to a full-scale output signal from the DAC.
- When you have completed entering the value, press ENTER to accept the entry and move to the next menu, LEAVE SUB-MENU.

IMPORTANT: When you enter the DAC.FULL-SCALE sub-menu item, the DAC output (analog output) is forced to the full-scale output.

LEAVE SUB-MENU

The function of this sub-menu item is to allow you to quickly move to the next menu item, CONVERSION RATE without the need to move through all sub-menu items if only changing one.

Sub-Menu Action

- When LEAVE SUB-MENU appears on the display, press ENTER to move to the next menu item, CONVERSION RATE.

CONVERSION RATE

Allows you to view the rate at which data conversions are occurring in the ADC.

Action

- When CONVERSION RATE appears in the display, press ENTER to display the conversion rate in samples-per-second.
- Press ENTER to move to the next menu, CALIBRATION TYPE.

CALIBRATION TYPE

Allows you to choose the type of calibration technique you wish to use.

There are four choices:

SHUNT CAL.

In this form of calibration, the SC100 inserts a known precision resistor into the transducer circuit, which causes a predictable apparent signal. The SC100 then adjusts itself so that the indicator responds properly to this stimulus. This form of calibration is most applicable when the distances between the transducer and the instrument are short and not subject to a large amount of temperature variation.

MV/V CAL.

The full-scale transducer output, in millivolts-per- volt, is entered into the SC100 at the proper point in the SETUP procedure. This value is the "Calibration Factor" (shown on the transducer's calibration record) and will be used by the SC100 in mathematical calculations to scale the display. This technique is usually more accurate than shunt calibration, and will work with transducers which do not have shunt calibration values available.

KNOWN-LOAD CAL. (2-Point)

Calibration is performed manually, where you are prompted to enter values, then apply load to the transducer in the amount of the prompted value. This technique assumes that the transducer is linear, so the usual values are zero and full-scale.

KNOWN-LOAD CAL. (3-Point)

Similar to the 2-point case, but an extra point near mid-scale can be used, to help compensate for non-linearity of the transducer. The usual values are zero, half-scale and full scale, but you are not restricted to these values.

Action

- When CALIBRATION TYPE appears in the display, press ENTER to display the present selection.
- To change the type of calibration, press UP or DOWN until you see your choice in the display.
- To accept the displayed choice, press ENTER to accept the setting and move to the next menu item, CALIBRATION DATA.

CALIBRATION DATA

Allows you to enter values that will be used by the SC100 to calibrate itself to the transducer. You will be prompted to enter the proper values; which values you are asked to enter will be keyed to your choice of the type of calibration.

Action

- When CALIBRATION DATA appears in the display, press ENTER to see the first sub-menu, FULL-SCALE MV/V. If your transducer has *Signature Calibration*, you don't need to enter this value, because it was entered automatically by the transducer.

FULL-SCALE MV/V

The transducer output, in millivolts-per-volt, is used by the SC100 to set its amplification factor, and (in the case of the Millivolt-per-Volt Calibration Type) to calibrate the instrument. This value is normally found on the transducer calibration record issued by its manufacturer.

Sub-Menu Action

- When FULL-SCALE MV/V appears on the display, press ENTER to display the current setting. The first digit will be flashing.
- To change the setting, press UP (to increase the value) or DOWN (to decrease the value) until you see your choice in the display.
- Press ENTER to accept the displayed setting and move to the next digit to the right. When the last digit to the right is flashing, press ENTER to move to the next sub-menu, FULL-SCALE VALUE.

FULL-SCALE VALUE

Allows you to set the full-scale output in engineering units. If your transducer has *Signature Calibration*, you don't need to calculate this value, because it was entered automatically by the transducer.

Sub-Menu Action

- When FULL-SCALE VALUE appears on the display, press ENTER to display the current setting (in engineering units). The first digit will be flashing.
- To change the setting, press UP (to increase the value) or DOWN (to decrease the value) until you see your choice in the display.
- Press ENTER to accept the displayed setting and move to the next digit to the right. When the last digit to the right is flashing, press ENTER to move to the next sub-menu, which is a function of which type of calibration you have chosen. The choices are:
  - Shunt Calibration Next item is SHUNT CAL VALUE
  - MV/V Calibration Goes to LEAVE SUB-MENU
  - Known-Load Cal. Next item is KNOWN POINT 1

SHUNT CAL VALUE (Shunt Calibration Only)

Allows you to display or change the value that the SC100 will display with the shunt calibration resistor. If your transducer has *Signature Calibration*, you don't need to calculate this value, because it was entered automatically by the transducer.

To calculate the shunt cal value, use the formula:

$$\text{SC VALUE} = \frac{\text{SCO}}{\text{FSO}} \times \text{FSR}$$

where the terms have the following meanings:

	(Example)
SCO =**Shunt Calibration Output**	(1.5234 mv/v)
The transducer's output under shunt calibration conditions.	
FSO = **Full-Scale Output**	(3.0014 mv/v)
The transducer's full-scale output	
FSR = **Full-Scale Reading**	(2500 psig)

The transducer's desired full-scale reading.

Using the numbers shown as examples, you would calculate the SC Value as follows:

$$\text{SC VALUE} = \frac{1.5234}{3.0014} \times 2500.0 = 1268.9$$

Be sure to locate the ohmic value of the transducer's shunt cal resistance, which was used when the shunt cal information was taken. For SENSOTEC transducers, this is usually 59,000 (59K) ohms. Make sure that the installed shunt calibration resistor is the proper value. This resistor is the large one on the Amplifier board. See the illustration, Figure 4.3.

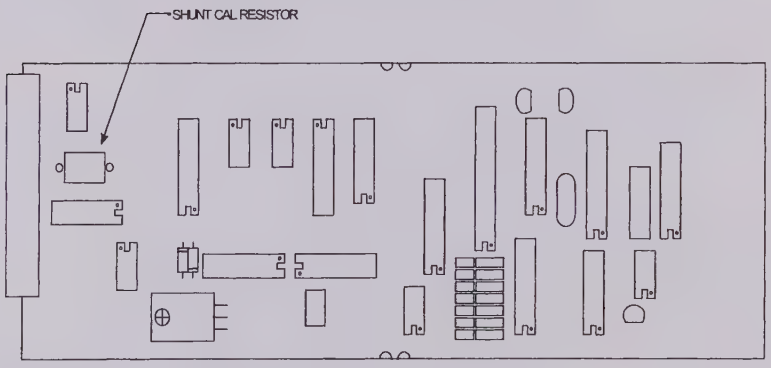


Figure 4.3 -- Amplifier Board Locations

Sub-Menu Action

- When SHUNT CAL VALUE appears on the display, press ENTER to display the current setting. The first digit will be flashing.
- To change the setting, press UP (to increase the value) or DOWN (to decrease the value) until you see your choice in the display.
- Press ENTER to accept the displayed setting and move to the next digit to the right. When the last digit to the right is flashing, press ENTER to move to the next sub-menu item, LEAVE SUB-MENU.
- To check this value on the display while in the RUN mode, press and hold the red TEST button for 3 seconds. This will apply the Shunt Resister and display the reading.

KNOWN POINT 1 (Known-Load 2-Point or 3-Point Cal Only)

Allows you to enter the engineering unit value associated with the first known-load calibration point. This value will, in general, be zero.

Sub-Menu Action

- When KNOWN POINT 1 appears on the display, press ENTER to display the current setting. The first digit will be flashing.
- To change the setting, press UP (to increase the value) or DOWN (to decrease the value) until you see your choice in the display.
- Press ENTER to accept the displayed setting and move to the next digit to the right. When the last digit to the right is flashing, press ENTER to move to the next sub-menu item, either KNOWN POINT MID (3-Point calibration type), or KNOWN POINT 2 (2-Point calibration type).

KNOWN POINT MID (3-Point Calibration Type only)
Allows you to enter the engineering unit value associated with the midpoint known-load calibration point. This value will, in general, be half-scale.

Sub-Menu Action

- When KNOWN POINT MID appears on the display, press ENTER to display the current setting. The first digit will be flashing.
- To change the setting, press UP (to increase the value) or DOWN (to decrease the value) until you see your choice in the display.
- Press ENTER to accept the displayed setting and move to the next digit to the right. When the last digit to the right is flashing, press ENTER to move to the next sub-menu item, either KNOWN POINT 2 (3-Point calibration type), or LEAVE SUB-MENU.

KNOWN POINT 2 (2- or 3-Point Calibrations only)
Allows you to enter the engineering unit value associated with the highest known-load calibration point. This value will, in general, be full-scale.

Sub-Menu Action

- When KNOWN POINT 2 appears on the display, press ENTER to display the current setting. The first digit will be flashing.
- To change the setting, press UP (to increase the value) or DOWN (to decrease the value) until you see your choice in the display.
- Press ENTER to accept the displayed setting and move to the next digit to the right. When the last digit to the right is flashing, press ENTER to move to the next sub-menu item, LEAVE SUB-MENU.

LEAVE SUB-MENU

The function of this sub-menu item is to allow you to quickly move to the next menu item, CALIBRATE, without the need to move through all sub-menu items, if only changing one.

Sub-Menu Action

- When LEAVE SUB-MENU appears on the display, press ENTER to move to the next menu item, CALIBRATE.

CALIBRATE

Allows you to actually perform the calibrations set up in previous steps. If you have chosen SHUNT CALIBRATION or MV/V CALIBRATION in the CALIBRATION TYPE menu item, pressing ENTER at this point will cause calibration to take place. If you have chosen KNOWN-LOAD CAL (either 2- or 3-Point), you will be prompted through the calibration steps.

Action

- When you see CALIBRATE in the display, press ENTER to proceed with the calibration.

If you have selected **SHUNT CALIBRATION**, the display will read DOING SHUNT CAL, and prompt you to APPLY 000000 XXXX (where XXXX is the engineering unit notation previously entered. When you have applied this no-signal input, press ENTER. The display will indicate WORKING, and calibration will take place. Upon completion, the display will indicate DONE, and the SC100 will return to RUN mode.

If you selected **MV/V CALIBRATION**, the display will read DOING MV/V CAL, then prompt you to APPLY 000000 XXXX (where XXXX is the engineering unit notation previously entered). When you have applied this no-signal input, press ENTER. The display will indicate WORKING, and calibration will take place. Upon completion, the display will indicate DONE, and the SC100 will return to RUN mode.

If you selected either **2-POINT CAL** (Known Load) or **3-POINT CAL** (Known Load), the display will read DOING 2 (or 3) POINT CAL, then prompt you to APPLY 000000 XXXX (where XXXX is the engineering unit notation previously entered). The 000000 number will be the same value you entered in the KNOWN POINT 1 step in the CALIBRATION DATA menu, above. When you have applied this input, press ENTER. The display will read WORKING, then APPLY YYYYYY XXXX, where the YYYYYY number will represent either the KNOWN LOAD MID value (3-Point calibration) or the KNOWN LOAD 2 value (2-Point calibration).

When you see APPLY YYYYYY XXXX, apply this load and press ENTER. The display will indicate WORKING. If this is a 2- Point calibration, the display will read DONE, and return to RUN mode. If it is a 3-Point calibration, the display will indicate APPLY ZZZZZZ XXXX.

When you see APPLY ZZZZZZ XXXX, apply this load and press ENTER. The display will indicate WORKING, then DONE, and return to RUN mode.

UPDATE SIG. MOD

Lets you update the information stored in the *Signature* module with any new settings that you entered into the SC100 during the setup procedure. Updating enters these new settings directly into the *Signature* module. If you do not update the *Signature* module, the next time you power up the instrument, the SC100 will revert to previous settings when it reads the *Signature* module.

The two options for this menu are:

- YES updates the *Signature* module information. When the process is complete, the instrument returns to RUN mode.

IMPORTANT: After you select YES, pressing ENTER causes the SC100 to update the Signature module information, instead of simply accepting the new setting, as in most menu items.

- NO means you don't want to update the *Signature* module.

Action

- When UPDATE SIG.MOD? is displayed, press ENTER to display "NO".
- If you want to move to the next Channel menu item **without** updating the *Signature* module, press ENTER when "NO" is displayed. This moves you to the next menu item (DEFAULT SIG.MOD?).
- If you want to update the *Signature* module information, first change the setting by pressing UP or DOWN until you see "YES" in the display. Then press ENTER when "YES" is displayed. This updates the *Signature* module. The SC100 displays the message "CH.1 UPDATED" and returns to RUN mode.

DEFAULT SIG.MOD?

Lets you overwrite any user settings with the original default settings in the *Signature* module. The SC100 always maintains a copy of the original default settings that were created for the *Signature* module at the factory. This allows you to revert to the default settings at any time.

The two options for this menu item are:

- YES overwrites the *Signature* module information with the original default settings. When the process is complete, the instrument returns to RUN mode.

IMPORTANT: After you select YES, pressing ENTER causes the SC100 to revert to the Signature module default settings, instead of simply accepting the new setting, as in most menu items.

- NO means you don't want to revert to the default settings.

Action

- When DEFAULT SIG.MOD? is displayed, press ENTER to display "NO".
- If you want to move to the next Channel menu item **without** reverting to the defaults, press ENTER when "NO" is displayed. This moves you to the first menu item, AUTO-ZERO. At this point you can press EXIT to leave SETUP mode and return to RUN mode. If you prefer, you can continue making changes to the Channel menu settings.
- If you want to revert to the default settings of the *Signature* module, first change the setting by pressing UP or DOWN until you see "YES" in the display. Then press ENTER when "YES" is displayed. The SC100 reverts to the defaults and displays the message "CH.1 DEFAULTED" and returns to RUN mode.

5.1 Overview of the Communications Process

The SC100 is designed to communicate with a remote computer system or terminal for the purpose of transferring data values from the SC100 to the remote system. The remote computer or terminal also can control many of the functions performed by the SC100.

A DB-25 serial communications connector is mounted on the rear of the Microprocessor board, and it uses standard terminal designations.

This chapter contains information about communications protocols, transmission formats, and some available commands.

A "Serial Communications Guide" is available to assist with the hookup and wiring for data communications as well as provide detailed information of all the available commands. Ask for manual 008-0385-00, Serial Communications Guide, at no charge.

5.2 Protocol

The SC100 is available with either of two communications protocols, RS-232 or RS-485. It is possible to have up to 127 channels with associated transducers on a single communications link. However, the protocols limit the number of channels and distances in the transmission paths.

EIA RS-232

EIA RS-232 standards provide for only one receiver and transmitter per loop, and a loop length of no more than 50 feet.

RS-485

RS-485 standards allow up to 32 devices per loop, and a loop length of no more than 4000 feet. All devices receive messages in parallel on the line, the so- called "multi-drop" system. To avoid garbled transmission, only one device should respond to a particular message. Therefore, every SC100 on the loop must have a unique address.

If you have an SC100 with more than one channel, transmission must be addressed to the appropriate channel within the instrument.

5.3 Transmission Formats

The standard format used for messages to and from the SC100 is 8 data bits, no parity, with 1 stop bit, at 9600 baud.

Messages from the SC100

Messages from the SC100 are in standard ASCII format.

For example, the SC100 would send the following message to indicate that the load seen by a load cell is 49.5 lbs:

000049.5

Each message is followed by a carriage return. If the automatic line-feed (AUTO LINE-FEED) feature is enabled, a line-feed character (ASCII code 10) precedes the carriage return.

Transmission to the SC100

To change any of the parameters associated with communications or for any other type of transmission to the SC100's channels, use the format:

#WWXXYYZZZZZ^

where the components have the following meanings:

#

is called the "come-alive" character, which alerts all SC's that a message is coming, causing each instrument to enter its receive mode.

WW

is the SC100 address (two ASCII characters).

XX

is the address of the channel (two ASCII characters). For "Channel" commands (those applying to a specific channel) these characters are needed. For "System" commands (those which apply to all channels, such as excitation voltage) these characters are not necessary.

YY

is the command code. For a list of valid command codes, see Section 5.4.

ZZZZZ

represents data information (up to 15 characters, including decimal point, if needed).

^

represents a carriage return.

5.4 Available Commands

The following tables provide lists of some of the available FUNCTION and WRITE commands. You can use these two-character codes as the command code (YY) in transmitting to the SC100.

FUNCTION Commands (partial list)

Code	Function	Code
F0	Transmit displayed data	Both
F1	Tare out signal on this channel	Chan.
F2	Remove tare on this channel	Chan.
F3	Calibrate the A/D converter on this channel	Chan.
F5	Apply shunt cal, transmit data on this channel	Chan.

WRITE Commands (partial list)

Code	Function	Values	Type
W1	Set baud rate	9600 = 0 4800 = 1 2400 = 2 1200 = 3 600 = 4 300 = 5	Syst.
W2	Set automatic line-feed	ON = 1 OFF = 0	Syst.
W4	Set this SC's address		Syst.
WI	Set continuous transmit of displayed values	ON = 1 OFF = 0	Syst.

Example: ***#0001F0 followed by a carriage return requests transmission of the last data point from Channel 1 of the SC100 at address 00. #01WI1 followed by a carriage return causes the SC100 at address 01 to continuously transmit its displayed values.***

6.1 The Package

The SC100 is housed in a 3/8 DIN rugged aluminum case. The case measures 5.6" wide by 2.8" high by 8.5" deep.

Be sure to remove the power cord from the power source before attempting to remove the instrument from its case. Loosen the five Phillips-head machine screws that secure the back panel of the instrument to the case. These screws are located on the rear of the case, one at each of the four corners and one in the middle.

The instrument is painted with ripple-finish black powder coating, making it highly resistant to scratches and marks.

6.2 The Front Panel of the SC100

Figure 6.1 shows the front panel and controls of a typical SC100.

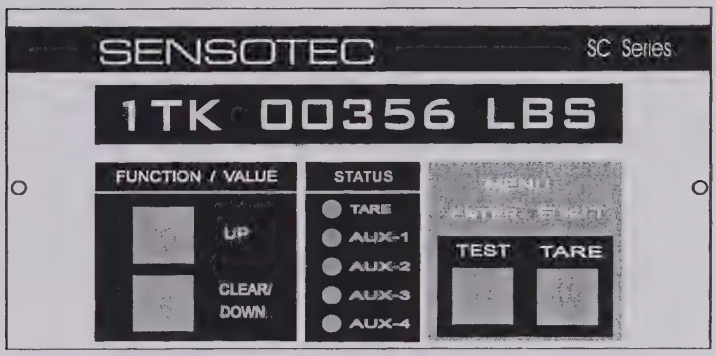


Figure 6.1 -- A Typical SC100 Front Panel

The Display

At the top of the front panel is a 16-digit vacuum fluorescent display, where calibration values and menu items are displayed.

The Controls

Below the display, the front panel has three sets of controls.

- Two FUNCTION/VALUE buttons (UP and CLEAR/DOWN).
- Five STATUS indicators (LED indicators for TARE and auxiliary functions, if used).
- Two MENU buttons (ENTER and EXIT when the SC100 is in SETUP mode). These same two buttons perform TEST and TARE functions, respectively, when the SC100 is in RUN mode.

The SC100's panel is generic, so it may change for a customer's application. For example, the ENTER/ TEST button shown in the illustration might be used to turn on the display in another unit.

6.3 Printed Circuit Boards

The SC100 has printed circuit boards that are plugged together. These boards will slide out of the rear of the case as a unit. Figure 6.2 shows the names and locations of these boards.

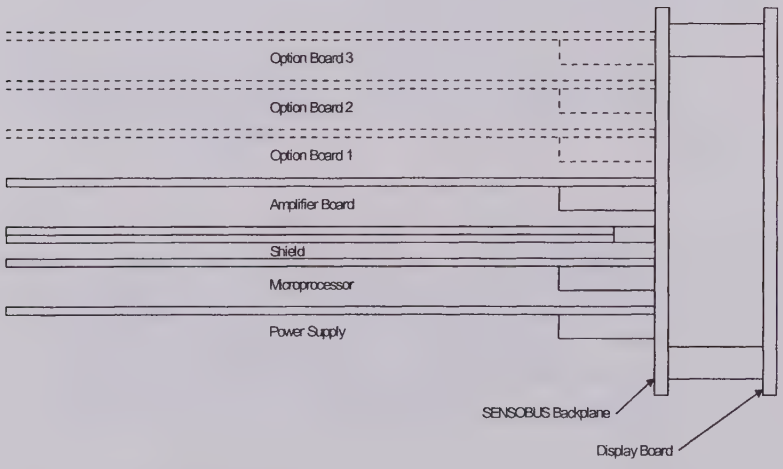


Figure 6.2 -- Board Locations

The following five boards are standard, and up to three additional option boards are available.

Display Board

The Display Board contains the display and all front panel controls. It is located forward of the other boards and is plugged into the SENSOBUS Backplane.

The functions of all lights and switches are controlled by the system software. SENSOTEC can alter these functions by changing the program stored in ROM. Thus, if you decide you want to make a functional change, a new ROM can probably be made to produce the desired results. Altered ROMs are available from SENSOTEC for a nominal charge.

SENSOBUS Backplane

The SENSOBUS Backplane Board serves as the connection between all boards in the system. It is located directly behind the Display Board.

This bus consists of seven connectors wired in parallel. Six of the connectors are 42 pins, and one is 20-pin.

Power Supply

The Power Supply Board is located directly behind the SENSOBUS Backplane Board, at the left side of the case. It contains the +15V, -15V, +5V, +2.5V Ref, -2.5V Ref, and the Excitation supplies (+ and -) for transducers.

Normal power for the system is 110VAC, 60 Hz. Alternately, a 220VAC, 50 Hz source may also be used, with proper changes on the Power Supply Board to accommodate this voltage. Contact SENSOTEC for appropriate procedure.

Microprocessor Board

The Microprocessor Board contains the microprocessor itself (68HC11), ROM, communications circuitry, and the serial link to other boards. It is located to the right of the Power Supply Board. All interboard communication is conducted in the SC100 serially, thus minimizing the amount of cabling needed.

Amplifier Board

The Amplifier Board contains the signal amplifier, a microprocessor, the analog-to-digital converter (ADC), and the digital-to-analog converter (DAC) circuitry. This board is located to the right of the Microprocessor Board; a metal shield separates the two boards.

Additional Option Boards

Three additional board locations on the SENSOBUS are reserved for other options or additional channels.

Additional option boards for special functions are available. Each has a supplemental manual to describe its operation.

6.4 Replacing the Power Line Fuse

The power-line fuse is located within the instrument's power connector assembly on the rear panel. Turn the instrument off and remove the power cord from the back of the instrument before replacing the fuse.

There is a small slot on the top of the power connector assembly. Place a small, flat-bladed screwdriver into this slot and gently pry open the back of the power connector assembly. You should use a 15/100 amp, 250 volt, size AG3, slow-blow fuse (SENSOTEC part number 029-3003-00).

Appendix

A.1 Error Codes

The SC100 displays an error code when it cannot accomplish its intended mission. Each code is a four-digit number that displays the channel number and error code in the format:

ERROR XXYZ

where **XX** is the 2-digit channel number, and YZ is the 2-digit error code. For example, ERROR 0141 represents Error #41 on Channel 1. The following table lists error codes with the probable cause.

	Error Code	Meaning of Code	Possible Cause/Solution
System	01-12	Floating point error	Incorrect setup information.
	20	Channel Number greater than 15	Cycle the power off and on.
	21	Stack Corrupted	Cycle the power off and on.
	22	Card type not found	Cycle the power off and on.
	25	Check character read error from Signature module	Try again. Usually noise causes this problem.
	26	No Signature module found	Cycle the power off and on.
	27-31	EEPROM communication error	Cycle the power off and on.
	33	Signature Module wires reversed	Correct wiring to Signature Module
	34	Type of card does not match the type of sensor/Signature Module	Connect a sensor/Signature Module of the correct type.
Amplifier	41	Shunt calibration out-of-range	Shunt Cal value too low or too high, or transducer lead open.
	60	Amp. Bd. Processor not responding	Cycle the power off and on.
	61	Known-Load Cal error	2nd or 3rd load point not larger than 1st.
	63,65	Known-Load Cal error	Applied load caused A/D converter overrange.
	64,66	Known-Load Cal error	Applied load caused A/D converter underrange
Math Channel	81-83	Mathematics Channel error	Bad instruction or operand in mathematics or option channel.

A.2 *Signature Calibration* Features

Strain-gage transducers are made to be linear devices, and a lot of attention is given to maintaining output linearity. This means that the signal conditioner/indicator used with such transducers is a linear device, and operates with a straight line equation:

$$y = m x + b$$

where:

y

is the displayed result in proper engineering units

x

is the stimulus (i.e., pressure or load)

m

is the slope (display change per unit stimulus change)

b

is the offset

Generally, instruments are zero-adjusted at no stimulus, so that the output value becomes the value of b and is simply subtracted to yield a zero output. Thus, the new equation becomes:

$$y = mx$$

In older instruments, a "zero potentiometer" was adjusted to remove offset. In more modern instruments (those employing a microprocessor), the value of b is merely subtracted mathematically.

The slope value, m, in older instruments was the amplifier gain. A potentiometer, called "gain" or "span" was used to relate the dependent and independent variables. When a microprocessor is used, this becomes a mathematical multiplier.

The problem is to find the slope. For a straight-line instrument this is a single number relating a single stimulus to the desired output when it is applied. The full-scale output of the transducer (called the "Calibration Factor") is specified by all cell manufacturers, usually in millivolts of output signal per volt of excitation (mV/V). If the instrument has "MV/V Calibration" (as does the SC100), this single number is sufficient to program the instrument, once it is entered.

A second technique is called "Shunt Calibration." For many years, strain-gage instruments have used this calibration concept, in which a known resistance is inserted across one leg of the transducer's bridge, thus producing a known off- balance condition. The instrument gain is then adjusted to produce the expected output. This technique was known by various names, including "R-Cal" and "Shunt Cal." Transducer manufacturers specify the cell output under shunt calibration conditions using a specified value of resistance (usually 59,000 ohms). If the zero is properly adjusted, then this single value will specify the slope, and all information necessary for calibration is available.

In the case of non-microprocessor instruments, the signal was applied (usually with a switch) and the gain potentiometer was adjusted until the display read the proper value. With microprocessor instruments, the value was entered in a number of ways, including the use of switches and counters. All of this was before *Signature Calibration*.

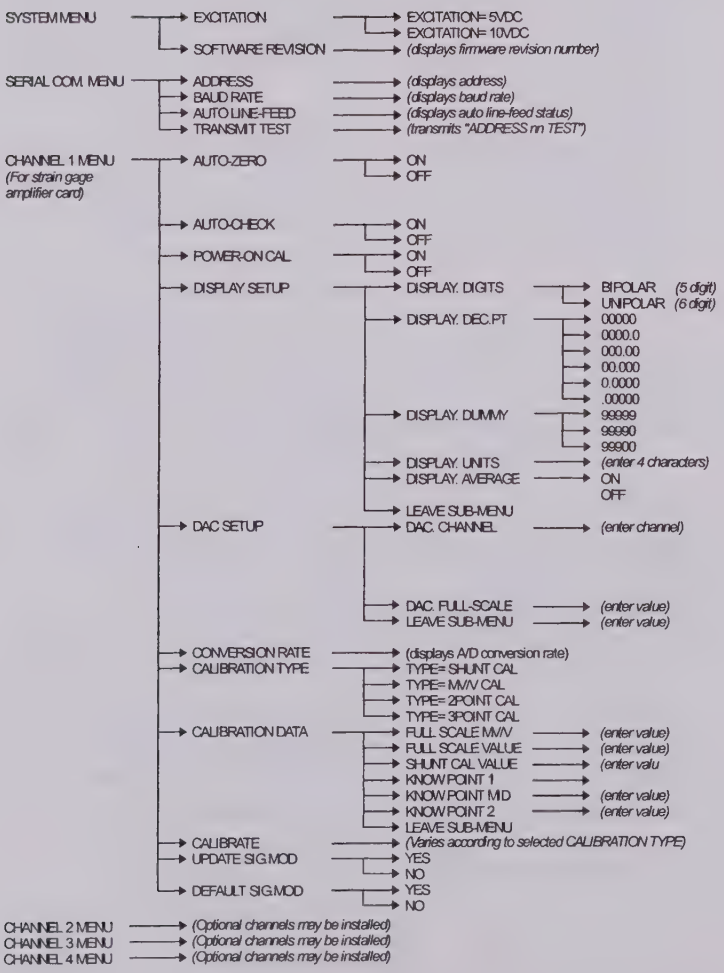
In *Signature Calibration*, the slope value (and other information) may be encoded within the transducer itself. Upon powerup, the instrument will attempt to read the information stored (or possibly stored) within the transducer. If a different transducer is connected, its coded information is different, so the instrument senses the new values. If no information has been stored within the transducer, the instrument will set itself up to the last characteristics it was given. Information can also be loaded into the instrument using the interactive front-panel setup procedure.

In transducers that have been designed to work with SENSOTEC *Signature Calibration* instruments, a battery-powered RAM memory is located inside. This memory uses a lithium battery with a guaranteed lifetime of 10 years. All data necessary to set up the transducer with the instrument is stored, and setup is automatic when the calibration function is activated.

The SC100 can also be set up using the front panel switches to enter calibration values into the system memory.

A.3 SETUP Menu Quick Reference Chart

- Enter the Setup Menus by pressing <UP> and <DOWN> together.
- Scroll through the available items using <UP> or <DOWN>.
- Select a menu item by pressing <ENTER>.
- Accept a value or setting by pressing <ENTER>.
- Leave the Setup Menus and return to Run mode by pressing <EXIT>.


SYSTEM MENU
EXCITATION
EXCITATION= 5VDC
EXCITATION= 10VDC
SOFTWARE REVISION
(displays firmware revision number)
SERIAL COM. MENU
ADDRESS
(displays address)
BAUD RATE
(displays baud rate)
AUTO LINE-FEED
(displays auto line-feed status)
TRANSMIT TEST
(transmits "ADDRESS nn TEST")
CHANNEL 1 MENU
(For strain gage amplifier card)
AUTO-ZERO
ON
OFF
AUTO-CHECK
ON
OFF
POWER-ON CAL
ON
OFF
DISPLAY SETUP
DISPLAY. DIGITS
BIPOLAR (5 digit)
UNIPOLAR (6 digit)
DISPLAY. DEC.PT
00000
0000.0
000.00
00.000
0.0000
.00000
DISPLAY. DUMMY
99999
99990
99900
DISPLAY. UNITS
(enter 4 characters)
DISPLAY. AVERAGE
ON
OFF
LEAVE SUB-MENU
DAC SETUP
DAC. CHANNEL
(enter channel)
DAC. FULL-SCALE
(enter value)
LEAVE SUB-MENU
(enter value)
CONVERSION RATE
(displays A/D conversion rate)
CALIBRATION TYPE
TYPE= SHUNT CAL
TYPE= MV/V CAL
TYPE= 2POINT CAL
TYPE= 3POINT CAL
CALIBRATION DATA
FULL SCALE MV/V
(enter value)
FULL SCALE VALUE
(enter value)
SHUNT CAL VALUE
(enter valu
KNOW POINT 1
KNOW POINT MID
(enter value)
KNOW POINT 2
(enter value)
LEAVE SUB-MENU
CALIBRATE
(Varies according to selected CALIBRATION TYPE)
UPDATE SIG.MOD
YES
NO
DEFAULT SIG.MOD
YES
NO
CHANNEL 2 MENU
(Optional channels may be installed)
CHANNEL 3 MENU
(Optional channels may be installed)
CHANNEL 4 MENU
(Optional channels may be installed)

A.4 Cabling Effects Upon Calibration

Accuracy of Calibration

The purpose of calibration is to accurately relate an instrument's output (visual or signal) to the stimulus being applied to its transducer. Each transducer manufacturer states the output of his product in a more-or-less standardized manner, usually by giving a value to the full-scale output in millivolts-per-volt. What this means is that, at the transducer's connector under full-scale stimulus, we will see the amount of signal specified.

The cabling with which the transducer is coupled to the instrument affects the accuracy of the calibration. In Figure A-1, a four-wire cable connects the transducer to the instrument. Each of the four wires has resistance, which will produce a voltage drop when current flows in the transducer. Assume that we are using #24 AWG wire, which has a resistance of 0.02567 ohms per foot. Therefore, in a 15-ft. cable, each of the resistances shown is 15 x .02567 = .385 ohms. For a typical 350-ohm cell with 10 volts excitation voltage, normal cell excitation current is 28.57 milliamperes. This amount of current, flowing through the wire resistances, will produce a voltage drop of 11 millivolts in each excitation lead, or 22 millivolts. Thus, with a 10-volt excitation supply, only 9.978 volts are actually across the cell, thereby reducing the full-scale output signal proportionately. This error is 0.22%, plus any other errors associated with the cell itself. Also note, we specified a 15-ft. cable. The percentage error would increase linearly with cable length.

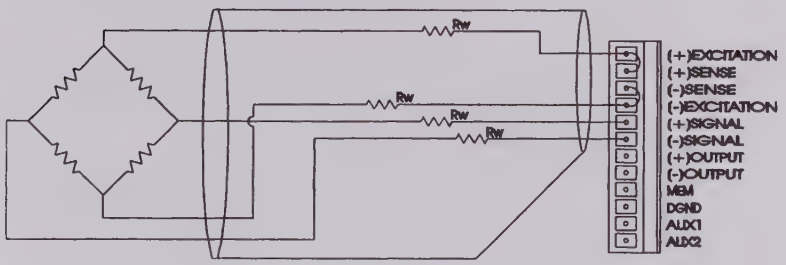


Figure A-1 -- Transducer and Cabling Schematic

It is evident that the cables can grossly affect calibration accuracy.

Solutions

Cable errors can be handled in several manners. In all cases, we effectively adjust the gain of the instrument to compensate for the reduced signal input.

1. Known Load Calibration

The simplest, most obvious answer to cabling losses is to apply known loads to the transducer. The SC100 can be calibrated with known loads. If the proper cable is in the circuit when calibrated, cable losses will automatically be corrected.

2. Millivolt-per-Volt Calibration

In the SC100 under millivolt-per-volt calibration, we enter a mV/V value as given by the transducer calibration record, then stimulate the transducer with a known value stimulus. With cabling losses, the result will be a low indication. We then enter a new value for the full-scale mV/V, related to the old value by the equation:

$$\text{New mV/V Entry} = \frac{\text{Displayed Reading}}{\text{Proper Reading}} \times \text{Old mV/V Entry}$$

The new mV/V entry is made, the instrument recalibrated, then the load again applied as a test.

For example, suppose that a 10000 lb load cell with a mV/V calibration factor of 3.0017 mV/V reads 9980 lbs when subjected to a full load.

$$\text{New mV/V Entry} = \frac{9980}{10000} \times 3.0017 = 2.9950 \text{ mV/V}$$

If this value is entered into the SC100 and it undergoes a calibration cycle, the readings will have been corrected, and accuracy restored.

3. Using Sense Leads in the Cable

The best method to compensate for cable errors for the SC100 is to sense the excitation voltage directly at the transducer (automatically), then adjust its algorithms to compensate for the errors. If the SC100 is connected to use remote sensing, the +/- Sense wires detect the voltage at the cell. No excitation current actually flows in these wires, because the sensing inputs are high impedance. The Sense wires are connected to the Excitation wires (+ to +, - to -) as close to the transducer as possible. See Figure A-2.

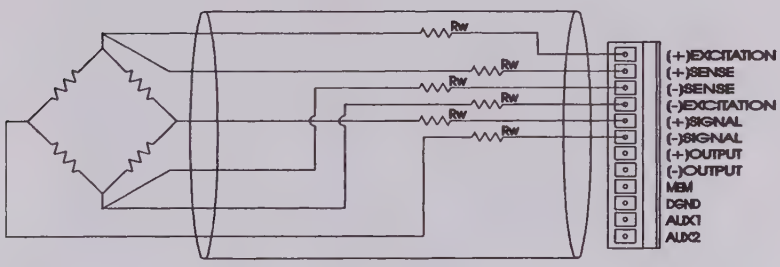


Figure A-2 -- Use of Power Supply Sensing

A.5 Warranty and Repair Policy

Limited Warranty on Products

Any of our products which, under normal operating conditions, proves defective in material or in workmanship within one year from the date of shipment by SENSOTEC, will be repaired or replaced free of charge provided that you obtain a return material authorization from SENSOTEC and send the defective product, transportation charges prepaid with notice of the defect, and establish that the product has been properly installed, maintained, and operated within the limits of rated and normal usage. Replacement or repaired product will be shipped F.O.B. our plant. The terms of this warranty do not extend to any product or part thereof which, under normal usage, has an inherently shorter useful life than one year. The replacement warranty detailed here is the buyer's exclusive remedy, and will satisfy all obligations of SENSOTEC whether based on contract, negligence, or otherwise. SENSOTEC is not responsible for any incidental or consequential loss or damage which might result from a failure of any SENSOTEC product. This express warranty is made in lieu of any and all other warranties, express or implied, including implied warranty of merchantability or fitness for particular purpose. Any unauthorized disassembly or attempt to repair voids this warranty.

Obtaining Service Under Warranty

Advance authorization is required prior to the return to SENSOTEC. Before returning the items, either write to the Customer Service Department, c/o SENSOTEC, Inc., 2080 Arlingate Lane, Columbus, Ohio 43228, or call (614) 850-5000 with: 1) a part number; 2) a serial number for the defective product; 3) a technical description (with information to assist us in understanding the application and the observed difficulty) of the defect; 4) a no-charge purchase order number (so products can be returned to you correctly); and 5) ship and bill addresses. At this time you will be issued a Return Material Authorization number (RMA#) on which to ship the unit(s) back to SENSOTEC. Shipment to SENSOTEC shall be at buyer's expense and repaired or replacement items will be shipped F.O.B. our plant in Columbus, Ohio. Non-verified problems or defects may be subject to an evaluation charge. Please return the original calibration data with the unit.

Obtaining Non-Warranty Service

Advance authorization is required prior to the return to SENSOTEC. Before returning the item either write to the Customer Service Department, c/o SENSOTEC, Inc., 2080 Arlingate Lane, Columbus, Ohio 43228, or call (614) 850-5000 with: 1) a part number; 2) a serial number for the defective product; 3) a technical description (with information to assist us in understanding the application and the observed difficulty) of the defect; 4) a purchase order number to cover SENSOTEC's repair cost; and 5) ship and bill addresses. At this time you will be issued a Return Material Authorization number (RMA#) on which to ship the unit(s) back to SENSOTEC. After the product is evaluated by SENSOTEC, we will contact you to provide the estimated repair costs before proceeding.

Shipment to SENSOTEC shall be at buyer's expense and repaired items will be shipped to you F.O.B. our plant in Columbus, Ohio. Please return the original calibration data with the unit.

Repair Warranty

All repairs of SENSOTEC products are warranted for a period of 90 days from date of shipment. This warranty applies only to those items which are found defective and repaired, and does not apply to products in which no defect was found and returned as is or merely recalibrated. Out-of-warranty products may not be capable of being returned to the exact original specifications or dimensions.